

12

WATER

REVISED
EDITION

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INTRODUCTION

Water is very important to living things. Without water there can be no life on Earth. All animals and plants need water. Man also needs water. We need water to drink, to cook our food and to clean ourselves. Water is needed in offices, factories and schools. Where else is water needed?

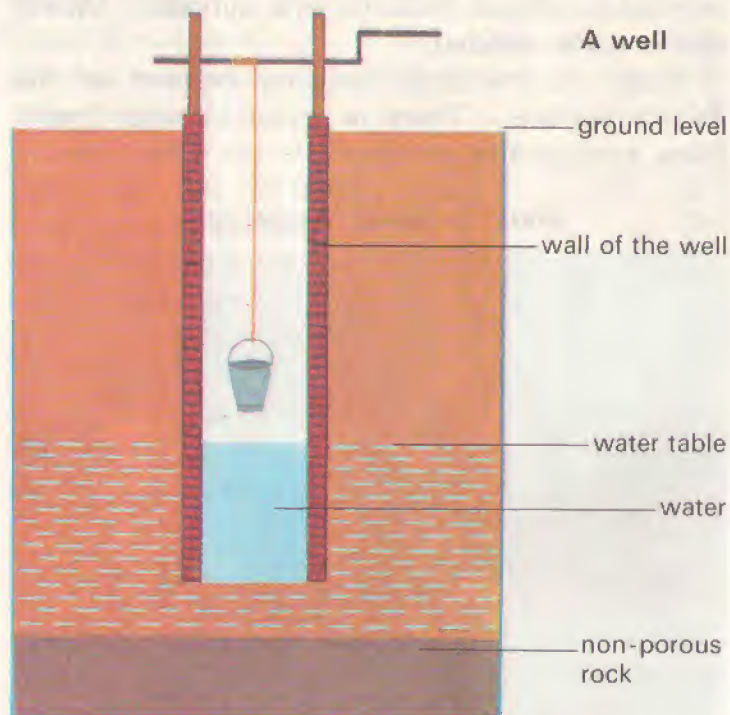
Water covers about seventy percent of the Earth's surface. There is water in seas, rivers, lakes, springs and wells.

Water is stored in reservoirs.



TYPES OF WATER

When water falls to the Earth as rain, some of the water sinks into the Earth, until it is stopped by a layer of **non-porous rock**. Non-porous rock is firm and solid. Water collects above this layer and saturates the soil. The height of the water-saturated layer of soil depends on the amount of rain which has fallen recently. The **water table** is the line which separates the water-saturated layer of soil from the drier layer of soil above it.



When the water table rises to the surface of the ground, a **spring** is formed. Spring water usually has a lot of minerals dissolved in it. Water that has certain minerals dissolved in it is called **hard water**. Hard water does not mix well with soap. That is why it is difficult to wash our clothes with hard water and soap. We have to "soften" hard water before we can use it.

Sometimes a deep hole is dug in the ground to reach the water table. Water then flows into the hole forming a **well**.

On the Earth's surface there are many **lakes** and **rivers**. Lakes are deep hollows or **basins** which are filled with water. Rivers are channels of water which flow to the sea or to lakes. Most lakes and rivers get their water from rain and from springs.

Things to Do

You can make hard water by adding lime and then make it soft by adding washing soda. Add a little slaked lime to a jar full of water. Stir the mixture and filter it by pouring it through a piece of filter paper in a funnel into another jar. Pour half of the filtered liquid into an empty jar and add one tablespoon of washing soda. Then add the same amount of soap powder to both the jars. Shake them. Which jar produces more soap bubbles?

WATER CAN BE A LIQUID, A SOLID OR A GAS

Water is found almost everywhere. Even in the driest part of the world there is some water in the air. You cannot see it or feel it when it is part of the air. The water in oceans and lakes and streams is a liquid. The water in the air is not a liquid but a gas. We call it **water vapour**.

Clouds are made of water. They may be made of tiny drops of water. They may also be made of snow crystals. Snow crystals are tiny crystals of ice. **Ice** is frozen water or water that has become solid.

Water, you have found out, may be a solid, or a liquid or a gas. When it is a solid, it may be as hard as rock. When it is a liquid, you can pour it out of a container. When it is a gas, you cannot see it or feel it.

Things to Do

- (i) Take two glasses of different shapes. Pour some water into one glass. Dip a spoon into the water. Can the spoon go into the water easily? Is the water hard or soft?

Look at the water in the glass. Look carefully at the shape of the water in this glass. Now pour the water into the empty glass. When all the water is in the other glass, look at the shape of the water. Is the shape of the water the same as before?

From what you see, do you think that water has a definite shape? Can the shape of water be changed easily?

- (ii) Take a tray of ice cubes. Try to push a spoon into an ice cube. Is the ice hard or soft? Put one or two ice cubes into a glass. Does the ice change its shape? Is the bottom of the glass completely covered with ice? Leave the ice in the glass for about half an hour. What happens to the ice?

The three forms of water



Solid — ice



Liquid — water



Gas — steam

- (iii) Put some water in a kettle and heat the kettle. After some time the water boils. When water boils it changes into water vapour very fast. We usually call the water vapour that comes from boiling water by another name — **steam**. Steam comes out of the kettle through the spout.

Hold a metal spoon in front of the spout for a few seconds. Remove the spoon from the spout. What can you see on the spoon? What is steam made of?

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WATER EVAPORATES AND CONDENSES

If you let a glass of water stand without a cover, the water will disappear, forming water vapour. When water changes to water vapour we say that it **evaporates**. If you heat water, you can make it evaporate faster. If you heat it long enough, you can make it boil. When water boils, water vapour forms very fast. When water vapour changes to water, we say that it **condenses**.

Water vapour forms very fast when water boils.



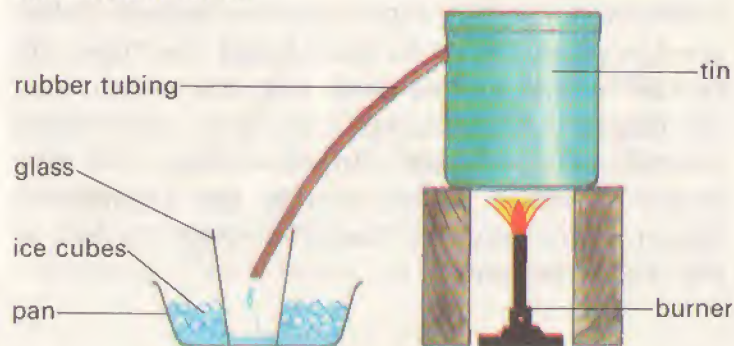
Things to Do

- (i) We can make water vapour condense by cooling it. Take an empty tin can. Fill it with ice and add water and a few drops of red ink. Let it stand on the table for a short while. You will see that the can seems to be "sweating". Drops of water are formed on the outside of the can. The drops are

- not coloured so that they could not have been formed by the leaking of ice-water from the can. The water is formed by the condensation of the water vapour from the air.
- (ii) You can get pure water from salt water by evaporation and condensation. Make a still by using a tin with a tight-fitting lid and a nail-hole in the side. Place one end of a rubber tubing into the nail-hole. Place the other end of the rubber tubing into a clean, empty glass that has been placed in a pan filled with ice cubes.

Pour some salt water into the still and heat the still over a burner. When the salt water boils, the steam formed passes down the rubber tubing and condenses to water which drips into the glass. The water collected is pure water and does not taste salty. When all the water in the still has been boiled away, what is left behind?

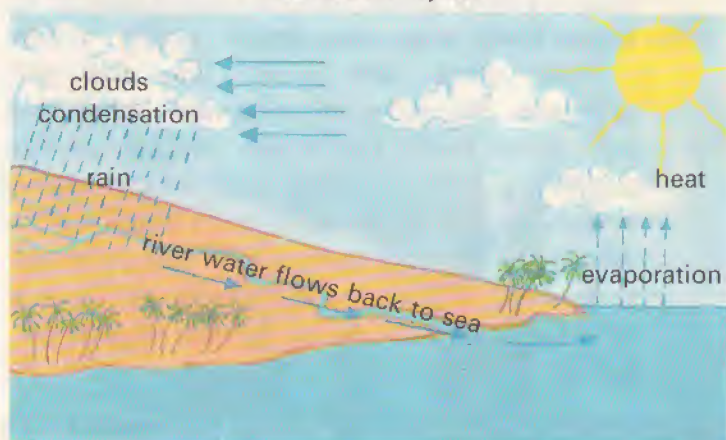
To get pure water from salt water by evaporation and condensation



WATER CYCLE

Water can change from one form to another easily. This is why we always have fresh supply of water. Let us find out how this is possible. The heat of the sun evaporates water from the oceans, seas, rivers and lakes. The heat also evaporates water from the ground and from plants and animals. Water vapour is formed. This rises and forms clouds in the air.

The water cycle



When the clouds come near a mountain, they are forced to rise. As the clouds rise, they are cooled. The higher they rise, the more they are cooled. This causes more and more water vapour to condense. In this way, the tiny drops of water in the clouds get bigger and bigger until they are heavy enough to fall to the Earth as rain.

Some rain water which falls on the Earth is again evaporated by the sun's heat. Some of it sinks into the ground. It may be used up by thirsty plants. It may reach a well or a spring. Most of the water goes back to the rivers, seas and oceans. This process then starts all over again. This process is called the **water cycle**.

WATER IS NOT PURE

As rain begins to fall from the clouds, it is very pure. However, as it falls through the air it dissolves some of the gases in the air. It also collects bits of dust and microbes that are floating in the air.

When the rain reaches the ground it begins to pick up more dust and dirt. Many kinds of mineral substances dissolve in the water. Substances like sand and mud are not soluble in water.

Some of the impurities are harmful, whereas others are harmless. Many microbes are harmful. They are so small that we cannot see them. These microbes must be removed or killed before the water is suitable for drinking.

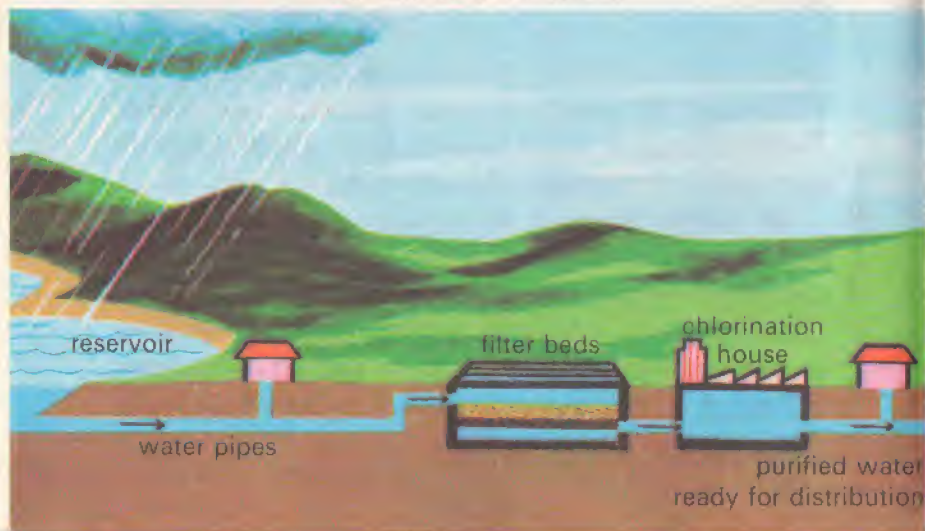
At home harmful microbes in the water can be killed by boiling. Gases and the fine particles can be removed by filtering the water through charcoal. You can also purify water by boiling it and condensing the steam which you have collected. This process is known as **distillation**.

Since water is so important to us, it is very important that the water we use should be clean. Otherwise, we might get some of the diseases that are carried by water. For example, microbes of diseases like cholera and typhoid live well in water. If the water supply is not clean, people who drink this water may get these diseases. Thus, to provide the people with clean water, the government purifies the water.

Purification is a long process and consists of three stages: storing, purifying and distributing. The first stage is storing. Man-made lakes called **reservoirs**, are used for this purpose. Water from the rains, other lakes, streams and rivers is collected in the reservoirs. This water is usually dirty and muddy.

In the second stage which is purifying, water from the reservoirs is filtered in a filter

Purification of water



bed. Stones, sand and other unwanted particles are caught in the filter beds. After filtration, tiny microbes are still present in the water. These microbes are removed by 'airing' the water and by adding a chemical substance called **chlorine** to the water. This kills all the microbes in the water. After this the water can be safely used for drinking.

The third stage is the distribution of the purified water to homes, hospitals, offices, factories and other places. This is done through a network of pipes of various sizes. These pipes must be made of a suitable material.

SOLUBLE AND INSOLUBLE SUBSTANCES

Many substances — solids, liquids or gases — dissolve in water. When a substance dissolves in a liquid we say the substance is **soluble** in the liquid. When the substance does not dissolve in the liquid then it is an **insoluble** substance.

Some solids are more soluble in water than others. Solids such as sugar and salt are very soluble in water. Chalk powder is less soluble in water. Try to dissolve some sand in water. Is sand soluble in water? What other solids can you think of which are soluble in water?

Some liquids can also dissolve in water. Pour some copper sulphate solution into a glass of water and stir the mixture. What happens to the colour of the water in the glass? Would

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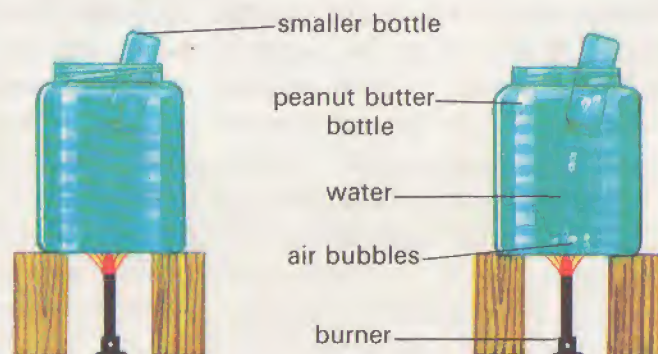
you say that copper sulphate solution is soluble in water? What happens when you mix oil with water?

There are many living things which can live in water. They need air to live. How are they able to get air in the water? Is there air in the water?

Things to Do

- (i) To find out if water contains air, take a peanut butter bottle and fill it with water. Invert a smaller bottle in the peanut butter bottle such that the former is also filled with water. Slowly heat the water. Can you see bubbles forming in the water? What are these bubbles made of? After some time what do you see inside the smaller bottle? This shows that water contains air.

To find out if water contains air

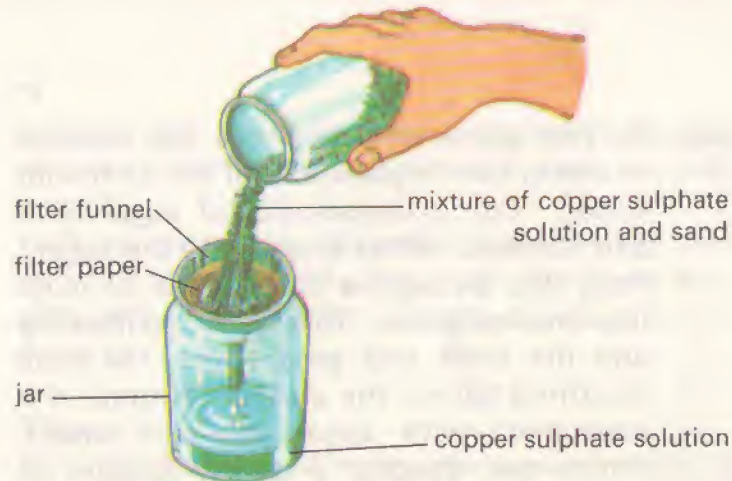


- (ii) To find out what substances can dissolve in water, take a glass and fill half of it with water. Put a teaspoonful of sugar in it and stir well. What happens to the sugar? Pour this through a clean piece of cloth into another glass. This is called **filtering** and the cloth acts as a **filter**. Is there anything left on the cloth? Repeat the experiment with sugar and hot water. Which will dissolve a greater amount of sugar, hot water or cold water?

Repeat what you have done, using each of these substances in turn: salt, chalk powder, sand, clay, copper sulphate and potassium permanganate. Which of these substances are soluble in water? Which of these substances remain on the cloth after filtering? Which of these substances is most soluble and which is least soluble?

To find out what substances can dissolve in water





To separate soluble substances from insoluble substances by filtration

- (iii) You can separate soluble substances from insoluble substances by doing this. Take a teaspoonful of clean sand and a teaspoonful of copper sulphate crystals. Mix the sand and copper sulphate together in a jar. Use the syringe to add 100 ml of water to the mixture. Stir or shake to dissolve the copper sulphate.

Use a filter funnel and paper to filter the mixture of copper sulphate, sand and water into a second jar. Why is the colour of the filtered liquid blue? What is left behind on the filter paper? Now pour the blue liquid into a dish and heat it over a flame. What is left in the dish? Leave some of the blue solution in a shallow dish for several days. What happens?

WHY THINGS FLOAT

When an object is placed in water, two forces act on it. One of them is a downward force caused by the Earth's pull. The other is an upward force caused by the upthrust of the water on the object. This upward force is equal to the weight of water displaced by the object. The larger the object, the more water it can displace, and the greater the upward force will be.

A small, heavy object will usually sink in water. Since the object is small, it displaces a small amount of water and so there is only a small upward force. Because the object is heavy, the downward force due to the Earth's pull will be great. When the downward force is greater than the upward force, the object sinks.

You often see large ships and boats floating in the sea or the rivers. Can you explain why these large and heavy objects do not sink?

Why is the ship able to float in the sea?



Things to Do

- (i) Take a basin and half-fill it with water. Collect the following objects: pieces of wood, corks, tin lids, stones, plastic, plasticine, pumice, coconut shells and green wood. Put the objects one at a time into the basin of water. Make a list of those objects that float and those that sink.

Pick up and feel those objects which float. Do the same for those objects which sink. What differences do you notice about these two sets of objects?

- (ii) Obtain two large, wide-mouthed jars and fill them half full with water. Add salt to the water in one jar and stir until no more salt dissolves. Now place an egg, first in the fresh water and then in the salt water. Talk about what happens.

Which bottle contains salt water?



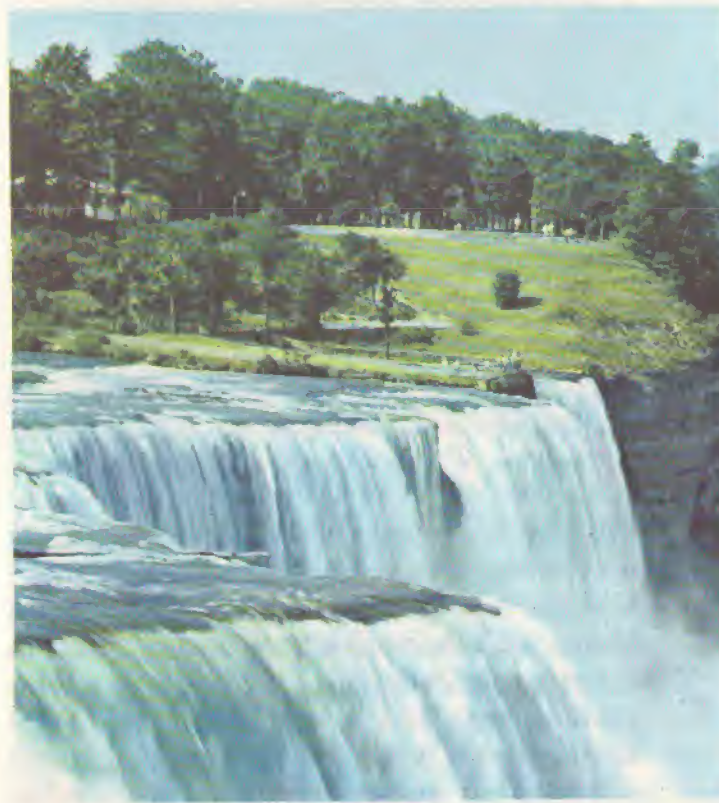
You have found out that an object floats more easily in salt water than in fresh water. Now you know why you find it easier to swim in the sea than in the lake.

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MOVING WATER CAN DO WORK

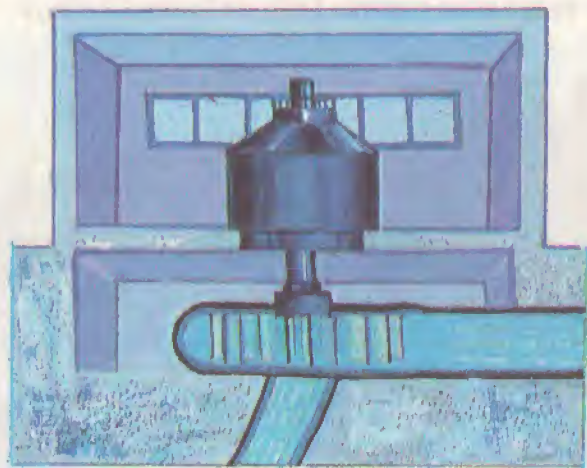
Fast-moving water, or water dropping from great heights has a lot of energy. This energy is called **kinetic energy**. Because of kinetic energy, the water can exert a great deal of pressure and force. The faster the water moves, the greater is its kinetic energy.

This waterfall has a lot of kinetic energy.



Moving water can be used to turn water-wheels. Some water-wheels are used to grind grains. Some are used to run machines in factories. Other special water-wheels, called **turbines**, are used to run large generators to produce electricity.

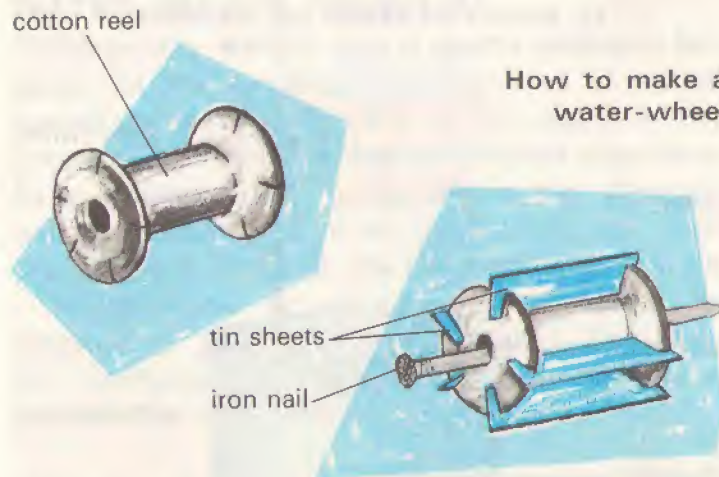
The turbine



Things to Do

You can find out how a water-wheel works by making one. Obtain an empty cotton reel and five pieces of small rectangular tin sheets. Fix the tin sheets to the reel, spacing them out equally as shown. Pass a long iron nail through the hole in the cotton reel so that it acts as an axle. Place the wheel under a tap and turn on the tap. What

How to make a water-wheel



happens when the water falls on the blades of the wheel? How would you make the wheel turn faster?

STEAM ALSO CAN DO WORK

You have learnt that when water boils, steam is formed. We can show how steam can be made to do work by building a **steam turbine**.

Things to Do

Make a water-wheel by using a cotton reel and tin sheets as in the experiment above. Pour some water into a can which has a tight-fitting lid. Make a hole on the lid and close the can with the lid. Place the can of water on a stand and heat the water with a candle flame. When the

To show that steam can do work



water boils, steam shoots out of the hole in the lid. Place the water-wheel above the hole as shown in the diagram. What happens to the water-wheel? What makes it turn?

WATER EXERTS PRESSURE

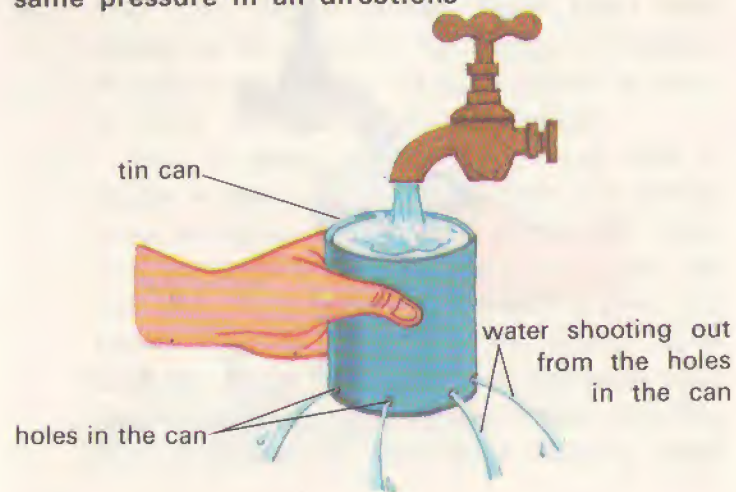
Water has weight and it exerts pressure because of its weight. This pressure is called **water pressure**. At any given depth in the water, the pressure is the same in all directions. At a deeper point in the water, the pressure will be greater. But at this depth the new pressure will again be the same in all directions.

When water is placed in a container, its pressure is greatest at the bottom. The taller the container, the greater will be the water pressure at the bottom.

Things to Do

- (i) You can show that water pressure is the same in all directions by doing this. Use

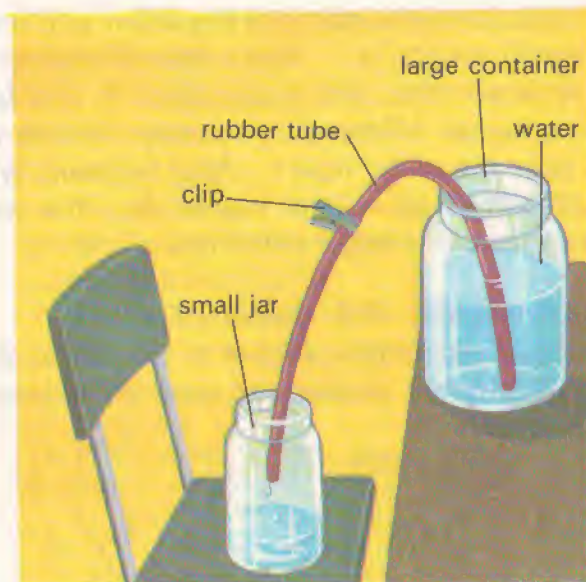
To show that at a given depth water exerts the same pressure in all directions



a hammer and a large nail to make holes all around the sides of a tin can at the same level. Take the can to the sink and run water into the can rapidly. Notice how the water shoots out to exactly the same distance from all the holes.

- (ii) To show that the depth of water affects water pressure, take a tall tin can and make three holes along one side of it. One hole should be near the top of the can, another in the middle and the third hole near the bottom. Take the can to a sink and run water into it rapidly. From which hole does the water shoot out to the farthest distance?

To show that water pressure increases with depth



How to use the siphon

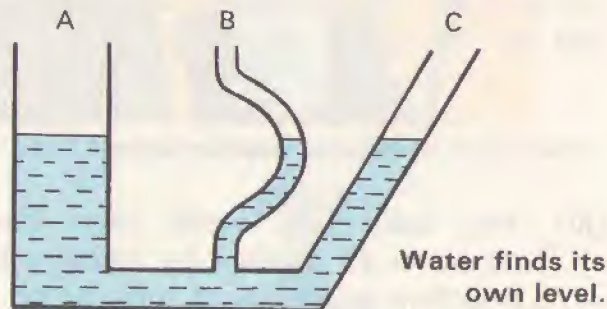
- (iii) You can make water flow from one container to another by using a **siphon**. A siphon is a piece of tube which is used to draw water out of a container.

Get a short rubber tube and put it inside a basin of water so that the whole tube is inside the water. Move the tube around under the water until no more air bubbles come out. This means that the tube is completely filled with water. Close both the ends of the rubber tube with your fingers and lift it out of the water. Quickly put one end of the tube into a large

container of water and the other end into a small empty jar. Make sure the small jar is lower than the water level in the large container. What do you see? Which way does the water flow? What happens when the small jar is held higher than the water level in the large container.

WATER FINDS ITS OWN LEVEL

The diagram below shows three tubes, A, B and C of different shapes and sizes all connected to one another.



When water is poured into tube A, the water also goes into the other two tubes. The water level in all the three tubes will always rise to the same level. This is why we say that, "Water finds its own level".

Things to Do

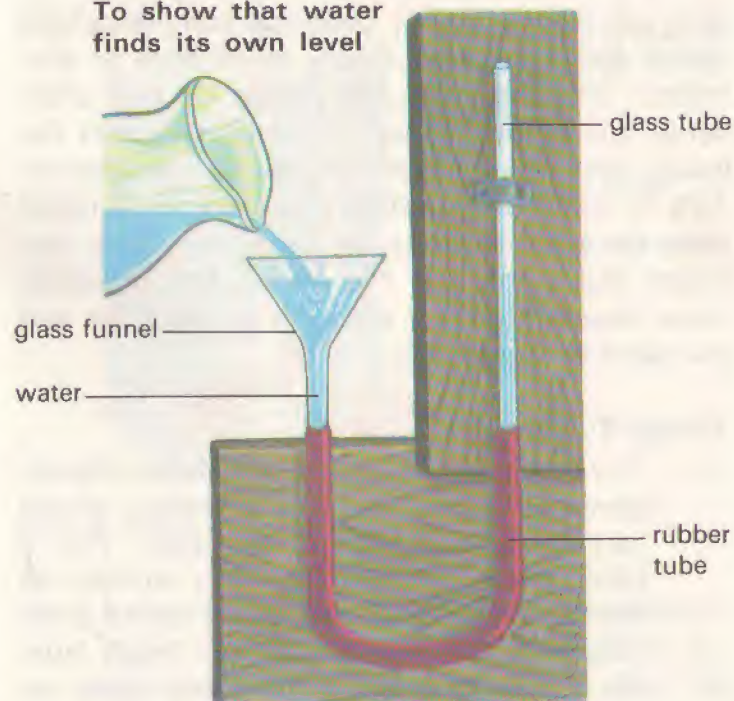
Take a rubber tube about 30 cm long and insert a glass funnel into one end of the

tube. Into the other end of the tube, insert a glass tube. Hold both the funnel and the glass tube upright as shown in the diagram. Pour some water into the funnel.

What do you notice about the level of water in both the funnel and glass tube? Are they the same?

Try raising and lowering the funnel a little and see what happens to the two water levels.

To show that water finds its own level



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time use different types of strips such as a blotting-paper strip, a paper towel strip, a newspaper strip and a wick or a string. Measure and record the results every five minutes. In which strip has the water climbed highest? In which strip has the water climbed least?

- (iii) Let's measure how far up water climbs in soil. Take a few plastic strips and roll them into plastic tubes. Use rubber bands or sticky tapes to hold the tubes in place. Put some cotton wool at the end of each tube and fill each with different types of soil. Then stand them in a dish. Fill the dish with water to a depth of 2 centimetres. Measure and record the height to which the water has climbed up the different types of soil.

To measure how far water climbs up in different types of soil

